Final Report

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Statement of Objectives: The present investigation was concerned with an accuracy assessment of engineering theories of elastic plates and shells subjected to suddenly applied surface loads. Such loading conditions are often encountered by military as well as civilian structures under common environmental conditions. "Exact" solutions to such problems are difficult to obtain, and comparative solutions of the same problem for different theories are almost non-existent for dynamical cases. It was the objective of this investigation to generate exact solutions within the framework of different plate and shell theories to guide designers in their selection of the appropriate theory when analyzing "light" construction under transient dynamical conditions.

Final Results Obtained on this Grant

An (exact) solution was obtained for the case of a cylindrical shell (in plane strain) subjected to an impulsively applied side load (see ref. 1). Three different mathematical models of the shell were employed, and substantial differences between the predicted deformations and stresses were found.

A series of cases dealing with freely supported cylindrical shells subjected to transient, non-axisymmetric loads were

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investigated (see references 2 through 4). It was found that even for moderately thick shells, major differences in the predicted response parameters became visible when an improved shell theory was compared to the conventional one.

A similar study was carried out for the axi-symmetric response of a shallow spherical shell under impact load (see ref. 5). There again sizable differences were noted when improved theories were compared to conventional (classical) theory solutions.

These, and other studies now clearly indicate that designers should regard the classical theories as inaccurate when considering transient, impact type loads which are concentrated in a very small region and/or when loads are applied to plates and shells which are not "thin." Improved theories which include the effects of shear deformation and rotatory inertia should be used in these cases.

References

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3. H. Reismann and J. Medige, "Forced Motion of Cylindrical Shells," Journal of the Engineering Mechanics Division, Proceedings of the ASCE, Vol. 941, No. EM5, Oct. 1968, pp. 1167-1182.

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5. H. Reismann and P. M. Culkowski, "Forced Axisymmetric Motion of Shallow Spherical Shells," Journal of the Engineering Mechanics Division, Proceedings of the ASCE, Vol. 94, No. EM2, April 1968, pp. 653-670.

6. H. Reismann and Y. C. Lee, "Dynamics of a Floating Ice Sheet," Journal of Hydronautics, (AIAA), Vol. 2, No. 2, April 1968, pp. 108-111.

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Paul M. Culkowski	M.S.	Ph.D. (pending)
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13. ABSTRACT

A brief description of the results of an investigation concerned with an accuracy assessment of engineering theories of elastic plates and shells subjected to suddenly applied surface loads is given. The objective of the investigation was to generate exact solutions within the framework of different plate and shell theories to guide designers in their selection of the appropriate theory when analyzing "light" construction under transient dynamical conditions.

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